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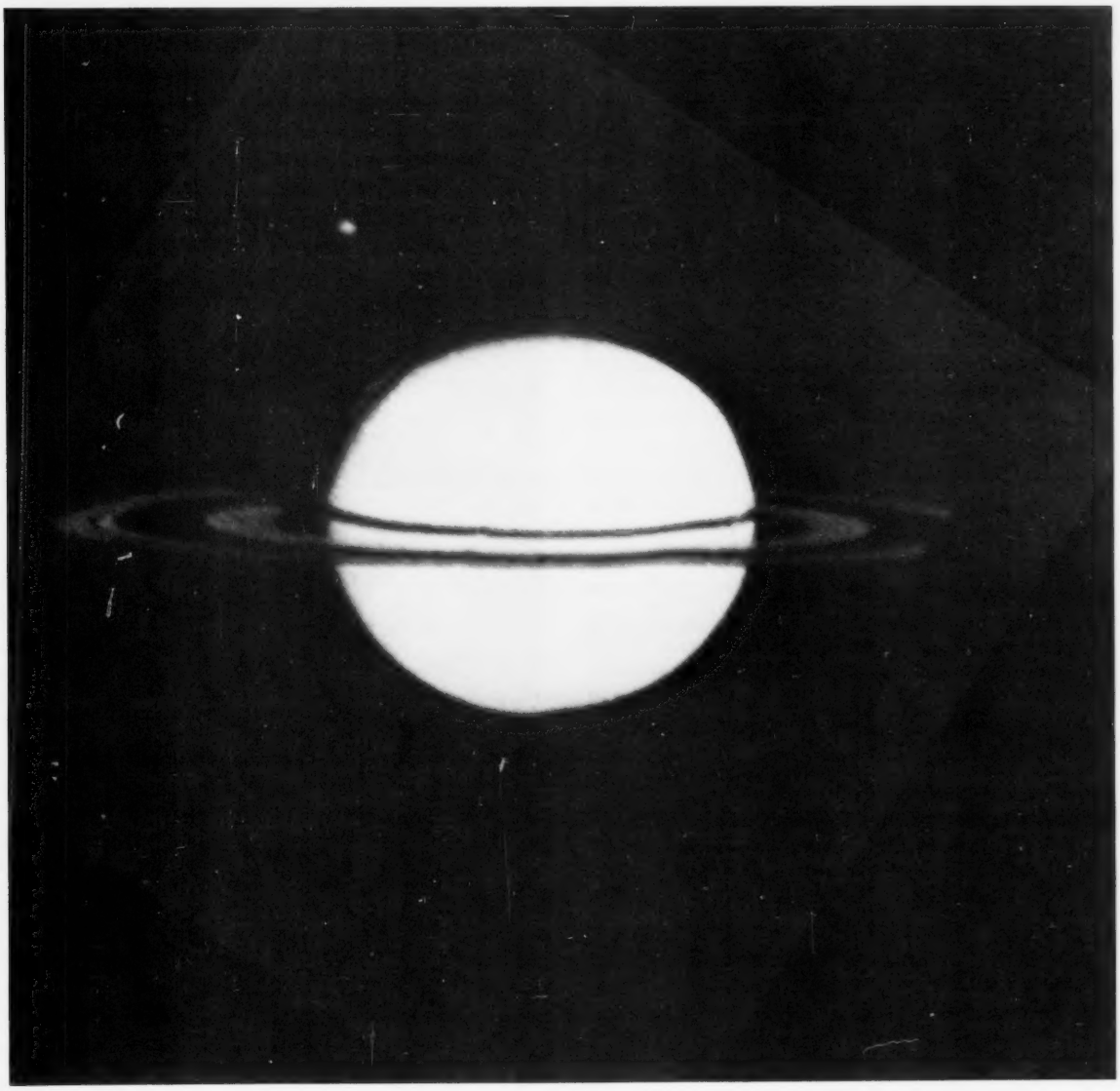

Cover

Pioneer 11 imagery produced this view of Saturn and its moon, Titan (upper left). Irregularities in ring silhouette and shadow are because of technical anomalies in the preliminary data, to be corrected later. The image was made at a distance of 2.8 million kilometers from Saturn.

Editor's Note:

This October issue of NASA Activities will be the last one published under my editorship—I will be leaving NASA Sept. 28. I want to take a moment to thank all those people at NASA who have been so helpful and patient during my tenure, particularly those in the various NASA centers who have been so responsive to hundreds of requests for information during the past four years. I am grateful to all of you.

Ann Weeks, Editor

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Pioneer Survives Encounter with Saturn

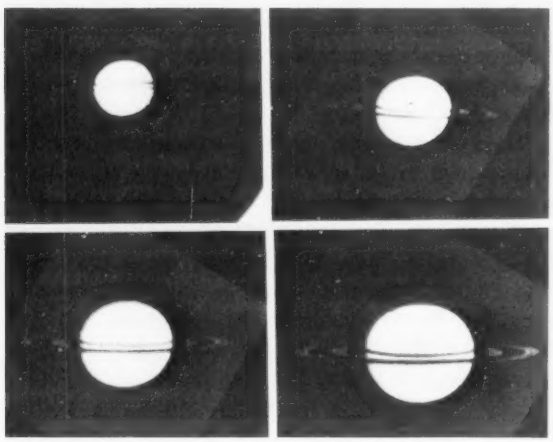
NASA's Pioneer 11 spacecraft reached the giant ringed planet Saturn on Sept. 1, after a six-year, three-billion-kilometer journey across the solar system.

And, according to the chief Pioneer scientist, the encounter has increased knowledge of the planet and its spectacular rings a thousandfold. Scientists have already listed more than 565 new discoveries, including a previously undetected ring and an 11th moon.

Pioneer 11 took the first closeup pictures and made the first close measurements of Saturn, its mysterious rings and several of its satellites, including the planet-sized Titan.

Sweeping through the most intense part of Saturn's massive radiation belts, Pioneer came within 21,400 km of the planet and as close as 1,900 km to the Saturnian rings. Closest approach was at 2 p.m. EDT, Sept. 1.

The images returned by Pioneer 11 (also called Pioneer Saturn) are providing five to six times more detail of the planet than the best of the pictures taken from Earth.



The Rings of Saturn—Pioneer 11 produced many images of Saturn and its rings as it closed in on the planet during a Sept. 1 encounter. The four photos were taken: (left to right, top) Aug. 22 at a range of 814 million kilometers; Aug. 25 from 5.5 million km; (l. to r., bottom) Aug. 26, from more than 5.5 million km; and Aug. 27 from 4.3 million km.

Information returned by the spacecraft is expected to contribute to a better understanding of the origin and evolution of the Sun and planets. This, in turn, should provide scientists with a greater knowledge of the Earth.

Data obtained by Pioneer 11 also will be useful in planning the encounters of Voyager 1 and 2 with the ringed planet in 1980 and 1981. The Voyagers are now Saturn-bound after 1979 encounters with Jupiter.

Saturn, the second largest planet in the solar system, is only slightly smaller than Jupiter. It is an immense, diffuse body whose volume is 815 times that of Earth, but whose mass is only 95 times greater. This makes Saturn the least dense planet in the solar system, on the average lighter than water. Like Jupiter, Saturn appears to be composed mainly of hydrogen and helium and its general characteristics suggest a liquid planet.

Appearing to the Earth observer as a bright yellowish star of the first magnitude, Saturn is the sixth planet from the Sun, around which it revolves at an average distance of 1.4 billion km, completing one orbit around the Sun every 29½ years. The years are long but the days are short—it rotates on its axis every 10 hours, 14 minutes. Difficult to observe in detail from Earth because of its great distance, Saturn is known to have a banded structure which is probably because of cloud systems similar to those of Jupiter.

Saturn's most distinctive trademark is its elaborate ring system—believed to consist of ice, ice-covered rocks or ice imbedded with rocks. The rings are one of the great spectacles of the solar system. Discovered by Galileo in 1610, they range outward about 77,000 km from Saturn's cloud tops. Total width of the three main rings is 64,800 km. The rings are so thin as to be nearly invisible when viewed edge-on from Earth. Astronomers have determined from Earth observations that the orbiting ring particles are partly, perhaps mostly, water ice. They also may contain metals, perhaps from the core of a disintegrated moon. There are few rocks. Most authorities think the particles range from the size of a snowball to that of an automobile. A few pieces may measure a kilometer or more.

The rings are believed to have originated either from the capture of a "wandering moon," which was then torn apart by Saturn's gravity, or—more likely—as a result of gravitational forces that prevented formation of a close-in satellite from the original planetary nebula.

Until the recent discovery of thin rings around Jupiter and Uranus—the two giant planets that flank Saturn—the Saturnian ring system was believed to be unique in that respect.

The Saturn encounter is the second planetary surveillance task for Pioneer 11. On Dec. 2, 1974, it skimmed within 42,760 km of Jupiter's cloud tops. That close passage permitted the gravity and motion of Jupiter to act as a slingshot, increasing the spacecraft's velocity and placing it on the trajectory which carried it to its August-September close encounter with Saturn.

The trajectory from Jupiter to Saturn is about three times as long as the first leg of Pioneer's outbound journey from Earth to Jupiter. Pioneer's trajectory carried it high above the plane of the ecliptic in which solar system planets revolve around the Sun, reaching a maximum height of about 160 million km in 1976.

As Pioneer neared Saturn, its trajectory lay above the ring plane and, since the ring plane is tipped up relative to the direction of the Sun, it is lighted from below. The view from Pioneer therefore was of a ring plane lighted from the other side, permitting optical measurements of a ring structure never before possible.

Picture resolution of Saturn began to exceed that from Earth on Aug. 26 as the spacecraft approached the planet at a distance of five million km. After Aug. 30, Pioneer was too close to Saturn to return images of the full planet with its rings.

At about noon on Aug. 31, the last picture of Saturn's full disc, without the rings, was made. Two hours before closest approach to Saturn itself, Pioneer made its most detailed picture, resolving cloud features of 80 to 100 km.

A critical event took place on the morning of Sept. 1, when Pioneer—traveling at a speed of 85,000 km/hr—passed through the plane of Saturn's rings at a very shallow angle (4.7 degrees) on its descent toward the planet. Any planetary debris in the area, even impact with a small fragment could have disabled the spacecraft. Ring plane passage took about an eighth of a second.

As it rushed in toward Saturn, Pioneer approached from the north and crossed outside the edge of the outer ring at a distance of 34,600 km. It then skimmed in under the rings, from 2,000 to 10,000 km below them. At the point of closest approach, on the planet's night side, Pioneer came within 21,400 km of Saturn's banded cloud tops.

For more than an hour, Pioneer made the historic first passage under Saturn's rings, using closeup optical measurements to determine their structure and other original observations. The spacecraft was moving too fast for good ring pictures while it flew beneath the rings.

On its closest approach to Saturn's cloud tops, just before Pioneer passed behind the planet, it was traveling 114,100 km/hr. Closest approach was at 12:34 p.m. EDT spacecraft time. Earth-received time of spacecraft signals at NASA's Ames Research Center, which manages the Pioneers, was at 2 p.m. EDT. (Almost 1½ hours are required for radio signals to cover the Earth-Saturn distance of 1.4 billion km.) The spacecraft made another shallow-angle crossing of Saturn's ring plane on its ascent away from the planet.

On Sept. 2, Pioneer made its closest approach to Titan, Saturn's largest moon, taking pictures and making measurements of the satellite from 356,000 km away.

Titan is the largest known planetary satellite in the solar system, larger than Mercury. It appears to be wrapped in opaque orange smog and has a methane-containing atmosphere which may be as dense as that of Earth at the surface, and far denser than that of Mars. Titan's hydrocarbon atmosphere, thought to be very similar to the primordial atmosphere of Earth, may well have produced organic molecules, the building blocks of life.

Like Jupiter, Saturn has white, yellow and yellow-brown banded cloud belts which appear to be the tops of planet-circling atmospheric streams, driven by the ringed planet's rapid spin and by an internal heat source.

Pioneer 11 returned some 150 pictures of Saturn, after the first transmission on Aug. 20 at a distance of about one million km from the planet. The high resolution photographs were received at the Ames center from Aug. 26 until Sept. 8. The smallest object visible was about 95 km in diameter.

Travel time for the transmission of spacecraft data back to Earth (at the speed of light) is 86 minutes, compared with the 52 minutes required for Voyager 2 data to reach Earth from Jupiter in July 1979.

Pioneer is now heading out of the solar system, traveling in roughly the same direction as the solar system with respect to the local stars in our galaxy. A sister spacecraft, Pioneer 10, which flew past Jupiter for the first time in history in December 1973, also is on its way out of the solar system. It will be the first manmade object to leave our solar system. The exit path of Pioneer 10 is almost opposite to that of Pioneer 11 and it has already reached the orbit of Uranus.

On the outside chance that either of the Pioneers is captured by an intelligent species during their nearly endless travels among the stars, a message is attached to the spacecraft which describes Earth.

Pioneer Saturn weighs 260 kg and is spin-stabilized, giving its instruments a full circle scan nearly 8 times a minute. It uses nuclear sources for electric power because sunlight at Jupiter and beyond is too weak for an efficient solar-powered system.

Pioneer's 2.75-meter dish antenna looked back at Earth throughout the mission, adjusting its view by changes in spacecraft attitude as the spacecraft and home planet moved in their orbits around the Sun.

Pioneer carried a 30-kg scientific payload of 11 operating instruments. Two other experiments used the spacecraft and its radio signal as their instruments.

This most recent mission, at Saturn, was expected to:

- determine whether the planet has a magnetic field and belts of high-energy charged particles, and assess the effects of the rings on such belts;
- provide a temperature and density profile from the planet's cloud tops to its core;
- determine the presence of an internal heat source—how much heat Saturn is radiating—and effects of that heat on internal and atmospheric circulation;
- determine the masses of Saturn's two outer rings to find out whether the rings are made mostly of ice, or perhaps metals;
- determine the existence and character of the hypothesized outer "E-ring," which could double total ring width, and pose a hazard to Pioneer, the two Voyagers and future spacecraft;
- measure light intensity and polarization from the mysterious ninth moon, Iapetus, which is six times as bright on its leading hemisphere as on its trailing one; first findings of mass and density of the moon, Rhea; and confirm and improve these measurements for Titan;
- characterize Titan's atmospheric aerosols (smog), its atmosphere structure and temperature, and take its pictures;
- measure Saturn's hydrogen/helium ratio (its two main constituents) and determine atmospheric structure, layering and heat distribution, horizontally and vertically;
- study structure, temperature and flow of the atmosphere's belt and zone system, and obtain data related to composition of the atmosphere.
- make at least 50 closeup color pictures of Saturn, its rings and cloud tops.

The Pioneer 10 and 11 projects are managed by Ames. The two spacecraft were built by TRW Systems, Redondo Beach, Calif.

Astronaut Candidate Talks to Students—Astronaut candidate Guion S. Bluford (second from right) spoke to 180 Florida high school students during a symposium held at the Kennedy center. Bluford told the group about NASA and the Space Shuttle program and of NASA's effort to interest minority high-school students in science and technology.

NASA Executive Awarded British Medal

The British Interplanetary Society recently honored NASA's Robert F. Freitag by awarding him its Bronze Medal for "Outstanding Contributions to Aeronautics." Freitag is Deputy Director of the Advanced Programs Division at headquarters.

Presentation ceremonies were held at the American Embassy in London, with U.S. Ambassador Kingman Brewster presiding at a special meeting of the British society, the U.S. Office of Scientific and Technological Affairs and the International Communication Agency.

Freitag was praised for his ". . . outstanding work in promoting space travel for many decades and . . . valuable work to secure the development of space projects of high calibre."

In his acceptance statement, Freitag said, among other things: "Space flight represents a massive investment in material resources, critical manpower and financial investment. What is the practical return on this investment?

"Already, the world is seeing many operational space systems for communications—with over 75 satellites operating routinely for intercontinental and domestic communications, yielding vastly improved transfer of information at a fraction of the cost of their predecessor systems.

International Recognition—Presentation of British Interplanetary Society's Bronze Medal to Captain Robert Freitag (L.) by Gordon V. E. Thompson, president of the society, in London.

"Today, navigation satellites are routinely providing ship locations and other data to more than 2,000 ships on the seas—at all points on the globe, in all weather, for all nations—of a heretofore unachieved accuracy.

"Observation satellites are providing global weather data, crop assessment information, geodetic data for mapping and survey, and for invaluable defense purposes.

"The decade of the '80s can see these systems extended to provide permanent, eventually self-financing, services for worldwide communication, weather and ocean forecasting, Earth resources discovery and monitoring, determination of compliance with international arms agreements and the prediction of natural events of disastrous human consequences or broad-scale economic impact.

"From space, nearly all of today's functions are based upon a few simple concepts. A spacecraft orbiting the Earth serves either as a very high antenna for transmitting or receiving information; or as an observation platform for looking at Earth, at astronomical bodies or at other objects in space; or as a reference point or measurement benchmark or, in effect, an artificial star. Of increasing importance is a fourth function, of a base for doing things *in* space.

"It is this latter aspect that offers great opportunities for growth and expansion in space and significant benefits only vaguely perceived at this time.

"Space has at least six characteristics not found here on Earth. First, there is the great view, what we call the overview factor. The operational systems just mentioned depend on this characteristic. Second, there is an almost perfect natural vacuum which can be a boon to a great many manufacturing processes. Third, in Earth orbit there is almost total absence of gravity. You can build huge structures with the flimsiest of materials. Fourth, there is almost an unlimited supply of energy from the Sun. Fifth, space constitutes a vast disposal area for the rejection of heat or radiation and other by-products of manufacturing. Sixth, you can achieve what amounts to perpetual motion in space—a billion miles per gallon, so to speak.

"To capitalize on this environment, the world must improve upon the very expensive technique of using throw-away or expendable launch vehicles as has been the case in the first two decades of the Space Age. It has been the major goal of the USA in the decade of the '70 to achieve easy and

economical access into and out of space. The reusable Space Shuttle, nearing the completion of development, will achieve this goal. The Shuttle will permit routine operations in near space including the placement of conventional satellites as we know them today and will, more importantly, allow the establishment of permanent bases in orbit for the conduct of routine manned operations in space.

"By making entirely new working conditions accessible to man that cannot be duplicated on Earth in their entirety, the Shuttle and associated space stations will establish a departure situation for beneficial innovation, new industries and new operations not concretely predictable at this time.

"As the '80s unfold, the Shuttle, with its European-developed Spacelab, will begin the first experiments to bring about this coming era of space industrialization. The construction of large structures, perhaps a hundred meters or more in diameter, fabricated by 'hard-hats' in orbit, will open new possibilities for communications. Perhaps an early application will be a wrist-watch telephone system, global in scope, operating with its giant 'switchboard in the sky.' Or the processing of materials in the weightlessness environment of space that would permit entirely new properties and characteristics. Among the most promising avenues of exploration is, again, an orbiting system based upon fabricating very large solar collectors on orbit, perhaps several kilometers in size, to generate electrical power and beam this energy to receivers on Earth for distribution wherever needed. The possibility of space technology providing a source of inexhaustible, clean energy cannot be ignored.

"These opportunities, together with continued scientific explorations and even more advanced space transportation will open the cosmos in no less a fashion than did the explorations of the 15th and 16th centuries."

NASA Recruiting Astronauts

NASA is beginning to accept applications for Space Shuttle astronauts on an annual basis. This year, the period for submitting applications by civilians began Oct. 1 and ends Dec. 1.

Depending on the needs of the agency for pilots and mission specialists, a selection will be made from rosters of qualified applicants obtained as a result of this announcement. The rosters will be established annually.

Successful applicants will be asked to report to the Johnson Space Center in mid-1980 for a one-year training and evaluation program as astronaut candidates, after which pilot and mission specialist astronauts will be selected.

Those chosen as applicants will be assigned to the astronaut office and placed in responsible technical or scientific positions where they will receive assignments to the Space Shuttle Program and continue work in their scientific or technical fields, where practicable.

Pilot astronauts will control the Space Shuttle during launch, orbital maneuvers and landings and will be responsible for maintaining vehicle systems. Mission specialist astronauts will have responsibility for the coordination (with the commander and pilot) of Shuttle operations in areas of crew activity planning, consumables usage and other Shuttle activities affecting experiment operations. Mission specialists will continue in their chosen fields of research and will be able to propose, develop and conduct space experiments.

Pilot applicants must have a bachelor's degree from an accredited institution in engineering, biological or physical science or mathematics.

They must have at least 1,000 hours of "pilot-in-command" time in high performance jet aircraft, must pass a NASA spaceflight physical and be between 162 and 193 centimeters tall.

Mission specialist applicants, while not required to be pilots, must meet the same educational requirements and have at least three years of relatable experience. An advanced degree may be substituted for experience. Mission specialist applicants must pass a NASA spaceflight physical examination and be between 152 and 193 cm. tall.

Civilians may obtain application forms and information material by writing to Astronaut (mission specialist) Candidate Program or Astronaut (pilot) Candidate Program, Code AHX, NASA Johnson Space Center, Houston, Texas 77058.

Military personnel should apply through their respective military department, not directly to NASA. Procedures will be issued by the service branches.

Current regulations require that preference for appointment to Astronaut candidate positions be given to U.S. citizens when there is an adequate source of well qualified citizens available. Qualified minority and women applicants are encouraged to apply.

Twenty-seven astronauts currently are available as Space Shuttle crewmen, including 11 scientists. An additional 35 astronaut candidates selected in 1978 are in training to qualify for selection to Space Shuttle crews. The number of new candidates to be selected in 1980 will be determined by mission requirements and operational needs.

New Tractor Drivers Could Revolutionize Power Transmission

After more than six years of research and testing, a team of engineers at the Lewis Research Center, reports it is close to achieving a major advance in power transmission.

The development, known as the Nasvytis multiroller traction drive, is based on a concept of Dr. Algirdis L. Nasvytis. The Lewis center reports that its new drive is able to transmit high power loads at high speed ratios without the use of toothed gears and could replace gears in a broad range of applications.

NASA engineers, working in conjunction with Nasvytis, have made several key design changes in the traction drive roller geometries, resulting in successful operation of a 15-to 1 speed ratio drive in a test rig. Lewis also has successfully demonstrated a similar drive for an automotive gas turbine engine.

The traction drive shows promise of transmitting seven horsepower per pound as opposed to conventional gears which operate at about four horsepower per pound.

NASA engineers believe that the new drive, on a commercial basis, could find almost immediate application in the machine tool industry where—in the case of grinders and millers—ultra-high speeds could be achieved to produce vastly improved product quality and increased rates of production.

Similarly, in high-speed drive systems normally powered by gas turbines, the Nasvytis drive, as a speed increaser married to a conventional alternating-current electric motor, could accomplish the same results in a far more simple and less expensive manner.

As a replacement for both geared drives and conventional traction drives, multiroller traction drives could be used for other power transmission applications including automotive gas turbine engine drive trains, helicopter main rotor transmissions, aircraft drive systems, rocket engine turbopump drive systems, wind turbines and high speed turbomachinery.

More Power for Transmission—Flanking the new multiroller traction drive developed at the Lewis center are (left) research engineer Neil Anderson, and (right) Stuart H. Loewenthal, the Lewis researcher who led the six-year Lewis team effort. Demonstrating the operation of the device is Clevelander Dr. Algirdis L. Nasvytis, whose invention inspired the new drive.

Just as the internal combustion engine in aviation gave way to the jet engine so, too, may power transmission gears substitute for multiroller traction drives to transmit power in industrialized applications of the future.

According to Stuart H. Loewenthal, lead engineer for Lewis on the multiroller traction drive project: "We are just now beginning to find out exactly what these drive systems can and cannot do. Ultimately, this quiet, almost vibrationless means of transmitting power also could make a major contribution to minimizing the noise pollution that now surrounds us."

Loewenthal has been assisted in the project by engineers Neil Anderson of the Army Propulsion Laboratory at Lewis and Douglas A. Rohn, also of the Lewis center. The drive is commercially available under the name "Nasvytrac" through a company founded by Dr. Nasvytis, known as NASTEC, Inc., in Cleveland.

The traction drive idea itself is not new. Between 1879 and 1971 about 34 patents were issued to cover various fixed-ratio traction drive concepts. Of these, eight have been issued to Nasvytis.

Instead of gears, the Nasvytis traction drives are composed of a "planetary" cluster of smooth cylindrical rollers, bearing directly against one another. This configuration includes a "sun" roller in the center, two rows or more of "planet" rollers surrounding the sun roller and a solid "ring" roller enclosing the total complex. By introducing power to either the outer ring or to the central sun roller, one creates, in the first place a speed increaser, and in the second, a speed reducer.

Though some 20 different types of adjustable speed traction drives are available from a dozen or so U.S. and foreign companies, their widest use has been in Europe with increasing recent interest coming from Russia and Japan. Until now, the conventional drives have been limited to light-duty assignments. The majority of those in use today handle loads no greater than 15 horsepower; some have a maximum power rating of 100 horsepower, but are not extremely popular because they must weigh from 590 to 1,905 kilograms to achieve this power capacity.

Experience has shown that Nasvytis fixed-ratio traction drives are as efficient as their geared counterparts and less expensive and quieter. But the single row format used for nearly 90 years not only caused severe restrictions on their horsepower capacity, but limited their speed-ratio capability to about 7 to 1. In 1966, Nasvytis added two or three rows of variable diameter planet rollers to the system, freeing the concept for expanded power loads and speed ratio ranges.

The Loewenthal team at Lewis, after thousands of manhours of work, has confirmed a number of advantages that make this new version of the Nasvytis traction drive a highly attractive alternative to conventionally geared speed changers:

- For many applications they are simpler and less expensive to manufacture because they require no gear tooth design or cutting. In fact, the tolerances for their roller components are well within ordinary machine grinding limits.
- Because of their unique load balance geometry, they are lighter and smaller than conventional gear boxes and speed changers. A Nasvytis drive easily can be built to handle more than 500 horsepower and yet weigh only between 36 and 180 kg depending on speed ranges and duty cycles.
- They are as efficient as gear systems. In a recent NASA test, they performed at a measured efficiency of more than 95 percent at speeds to 73,000 rpm for 15 to 1 ratio.
- They are more reliable and less susceptible to breakdown and wear. Through the use of special traction fluids, their rollers never actually touch each other—the fluid provides a miniscule separation—which serves to virtually eliminate roller wear in addition to damping out drive line vibrations.

Measuring Noise Levels—A Boeing commercial airplane used the Kennedy center's Shuttle landing facility for a three-week series of noise measurement tests to evaluate the effectiveness of experimental noise reduction hardware planned for new Boeing airplanes. Boeing 737 and 747 aircraft flew over the runway, sometimes only 90 meters high, while acoustical engineers on the ground and a specially-instrumented Cessna 172 took noise and weather measurements. Instrumented vans also were used to collect acoustical measurements and surface weather data. The system used a series of microphones placed on high towers 10-m along a 450-m strip of the 5-kilometer long runway. Boeing officials said the Shuttle landing strip lent itself to the conduct of the tests because of the probability of good weather, the absence of other air traffic, the length of the runway, and the temperature and humidity at KSC.

Back Home Again—NASA's Space Shuttle orbiter *Enterprise* (OV–101), which was used in approach and landing tests at the Dryden center in 1977, soars over the X–1E aircraft. The X–1E is an offshoot of the X–1 aircraft which exceeded the speed of sound. The *Enterprise* arrived at Dryden following a six-day cross country trip from the Kennedy center. Overnight stops were made in Atlanta, St. Louis, Tulsa, Denver, Ogden, and the Vandenberg Air Force Base.

Lageos to Carry Out 25 Experiments

NASA has selected 25 scientific investigators to use data obtained from its Laser Geodynamics Satellite (Lageos) with ground-based laser ranging systems.

The investigators will study the relative movement and deformation of the Earth's tectonic plates; variations in the motion of the Earth's polar axis and the Earth's rotation; solid Earth and ocean tides; the Earth's gravity field; and satellite orbital perturbations.

Seventeen of the principal investigators are affiliated with U.S. universities, private concerns or other government agencies. Seven are from other countries—France, West Germany, the United Kingdom and the Netherlands.

Lageos is part of NASA's crustal dynamics project which is managed by its Goddard Space Flight Center. Objective of the project is to improve understanding of the dynamic behavior of the Earth which, in turn, should lead to a better understanding of earthquake mechanisms and crustal processes associated with the emplacement of mineral resources.

The satellite was launched May 4, 1976, into a near-circular orbit at an altitude of 5,800 kilometers and an inclination of 110 degrees to the equator. The satellite is an aluminum sphere with a brass core. It is 60 centimeters in diameter and weighs 411 kilograms. The surface of the satellite is covered with 426 optical cube corners (reflectors) which retro-direct any incident optical signal.

Lageos Investigators Meet—The 25 principal investigators recently selected to use data obtained from the Laser Geodynamics Satellite met at Goddard Aug. 28 and 29 to discuss their planned studies. They will use Lageos data to study the Earth's crustal dynamics. Shown here (left to right) are: Prof. Ivan I. Mueller, Ohio State University; Dr. David Smith, Goddard Space Flight Center and Working Group Chairman; Prof. Byron D. Tapley, University of Texas at Austin; and Prof. L. Aardoom, Delft University of Technology, Netherlands.

The initial phase of the Lageos mission was devoted to determination of the precise satellite orbit and to development of the laser tracking systems. In the current phase, Lageos is being tracked by ground-based laser systems at several locations around the world.

By accurately measuring the time for a laser pulse to travel to the satellite and return, the position of the laser system can be determined to about 10 cm. By repeated observations from several locations, the relative distance between laser locations and any time change can be determined.

Lageos ranging data will be obtained through use of mobile laser systems on Kwajalein Island and American Samoa in the Pacific; Western Australia; Owens Valley and Goldstone, Calif.; Ft. Davis, Texas; and the Haystack Observatory in Massachusetts. Data also will be collected by fixed lasers at the Goddard center; at the McDonald Observatory in Texas; on Maui Island, Hawaii; at a U.S. Air Force site in Florida and at others operated by the Smithsonian Astrophysical Observatory in Natal, Brazil; Arequipa, Peru; and Orroral Valley, Australia.

Lageos information also will be collected by lasers in several countries in Europe. Data from a transportable laser ranging system, currently under development for NASA at the University of Texas, will be available later this year. This highly mobile, truck-mounted, laser-ranging system is designed to obtain precise Lageos ranging data. It will support scientific investigations in the continental United States.

Several new space techniques provide unique capabilities for measurements of key geodynamics parameters. For example, crustal plate motion may be accurately measured by laser ranging to satellites, to retroreflectors on the Moon, and by very long baseline microwave interferometry using extragalactic radio sources.

The high accuracy determination of the Earth's gravity field and geoid with laser tracking and altimetry from geodetic satellites provides information about the density distribution within the Earth, an essential element in the interpreting of geophysical data relevant to geodynamics and resource location.

Before Lageos was launched, satellite laser-ranging experiments were conducted by attaching laser retro-reflectors to satellites performing a variety of missions. Lageos is the first NASA satellite designed solely for laser-ranging experiments.

The analysis and publication of the results portion of the investigations are generally planned for a period of three years and are to be completed by July 1982.

All principal investigators will become part of the Lageos Working Group chaired by the project scientist, Dr. David Smith. The working group will meet during the course of the investigations to discuss either progress or problems. The initial meeting took place Aug. 29 and 30 at the Goddard center.

Former NASA Scientist Participates in Chinese Expedition

Farouk El-Baz, research director of the center for Earth and planetary studies at the Smithsonian's National Air and Space Museum, recently took part in an expedition to China to investigate landforms in the Gobi, Tengri and Takla Makan Deserts.

The expedition, sponsored by the National Geographic Society, is part of a scientific exchange program. El-Baz and five other American scientists studied in China for four weeks in late July and August. A related investigation involves six Chinese scientists who will visit the deserts of the American Southwest in 1980.

The major objective of the recent expedition was to visit desert reclamation programs. The People's Republic of China, in its search for self-sufficiency, has made progress in halting the encroachment of desert on arable land and in developing methods of "sand farming." In addition to studying these programs and methods, the Americans lectured at various Chinese institutes.

The scientific research team included a geographer, an arid lands economist, a cultural ecologist, a botanist, an archaeologist and El-Baz, who is the expedition's geologist. Two staff members from the National Geographic Society also accompanied the group.

El-Baz, who was involved in the Apollo lunar program from 1967 to 1972, trained Moon-bound astronauts in geological observations and photography. In recent years, his attention has been focused on the application of research in space to the study of the Earth, particularly desert land-forms. El-Baz's previous expeditions, some in conjunction with NASA satellite research programs, have included explorations of American deserts and visits to the North African Sahara and the Arabian Peninsula.

The Chinese host of the American expedition was Peking's Institute of Geography of the *Academia Sinica*. At that institute and also at the Lanchow Institute of Desert Research, El-Baz lectured on study of the deserts from space and on the deserts of Mars as revealed by the Viking satellite program.

Midwestern College Features Space Studies

Antioch College in Yellow Springs, Ohio, entered the space age this year by offering for the first time in its long history a course on the social, political and scientific implications of space exploration.

The major focus of the course is the proposed colonization of outer space. Concepts to be considered include the economic, international, legal and other aspects of a vastly expanded human role in space. The college has reserved a place on NASA's Space Shuttle for various experiments and it is developing an interdisciplinary program in space studies geared especially for students of the social sciences and humanities. Faculty from all academic disciplines will be participating in the class.

Antioch also plans a lecture series featuring Princeton physics professor Gerard K. O'Neill, author of the "The High Frontier—Human Colonies in Space," and Peter Vajk, author of "Doomsday Has Been Canceled." Other speakers include Barbara Marx Hubbard, co-founder of the Committee for the Future; Dr. Stephen Cheston, President of the Institute for the Social Science Study of Space and publisher of the journal "The Space Humanization Series"; Honorable Edward Finch, Jr., Chairman, Aerospace Law Committee of the American Bar Association and former Special Ambassador to the United Nations; Michael Michaud, author, lecturer, and an employee of the Department of State.

Antioch College, whose faculty believes that the profound social, economic and political repercussions of the industrialization and colonization of space have been neglected by many higher institutions of higher education, also is developing for its students space-related jobs with companies and institutions around the country. The Antioch program requires that students work *and* study to qualify for graduation. The new space-related jobs will supplement the many employment opportunities already open to Antioch students.

A New Factor in Federal Labor-Management Relations

Title VII of the Civil Service Reform Act emphasizes that it is in the public's interest to protect the right of Federal employees to organize, bargain collectively and participate through labor organizations of their own choosing in decisions which affect them. That aspect of the 1978 Act focuses on labor-management relations in the federal service.

The cornerstone of Title VII is the establishment of the Federal Labor Relations Authority. Although that body assumes most of the duties carried out by the old Federal Labor Relations Council and the Assistant Secretary of Labor for Labor-Management Relations, it is not just an amalgamation of the two. The authority will provide mechanisms for union representation of employees; prosecute and adjudicate allegations of unfair labor practices; decide questions of what is and what is not negotiable by unions and agencies; and review questions of arbitrators on appeals.

The Assistant Secretary of Labor for Labor-Management Relations, who had the major duties under the last Executive Order in the areas of representation elections and unfair labor practices, has retained one duty under Title VII—enforcing the standards of conduct for labor organizations.

The importance of unions in the federal sector is evidenced by their increasing numbers. In 1902, only 180,000 Federal employees were members of unions. By 1978, there were close to 1.5 million members, accounting for 60 percent of civilian, non-postal Federal employees. At NASA, some 11,000, or 51 percent of the permanent personnel complement employees, today belong to collective bargaining units. The FLRA will provide employees with an opportunity—through duly selected unions—to participate in the formulation and implementation of personnel policies and practices affecting the conditions of their employment.

A result of the Reform Act is the expanded scope of negotiated grievances and arbitration. Collective bargaining still cannot be used on decisions of mission, number of employees or internal security. But most other matters previously excluded now can be negotiated. The FLRA will not determine which matters are genuine grievances and which should be arbitrated. All collective agreements will provide such determinations. The negotiated procedure would be the exclusive form available to bargaining unit employees on matters covered in the agreement, except in cases of adverse action or discrimination. Furthermore, all collective bargaining agreements must be for binding arbitration as part of the negotiated grievance procedure. The decisions of the arbitrator then may be reviewed by the FLRA.

The FLRA is composed of three full-time members and a general counsel, each appointed by the President with Senate approval. At this time, Ronald W. Haughton has been confirmed for the initial five-year term. Haughton is the chairman; Henry B. Frazier has been confirmed as a member; and Leon B. Appelwhaite has been confirmed as a member for a three-year term. The initial terms are staggered, but each term thereafter will be for five years.

H. Stephan Gordon has been appointed general counsel. He will be serving a five-year term. Gordon will be investigating alleged unfair labor practices and prosecuting complaints.

The principal office of the Federal Labor Relations Authority is located in Washington, D.C., with regional offices in Boston, New York, Washington, D.C., Atlanta, Chicago, Kansas City, Dallas, Los Angeles and San Francisco. Resident personnel are located in Cleveland, Denver, Nashville, Philadelphia, and Seattle.

Space Antiques—After more than six years in orbit, fragments of the fallen Skylab space station are examined at NASA's Marshall Space Flight Center by members of that center's Skylab reconnaissance team. The pieces landed in Australia. Left to right are: Billy Adair, electronics equipment and trajectory specialist; J. M. Jones, public affairs officer; Dr. Ray Gause, materials specialist; and William (Ozzie) Harrison, structures specialist. The team's mission in Australia was to learn more about the dimensions of the Skylab "footprint" as the spacecraft reentered Earth's atmosphere, and the condition and precise location of the debris.

Magnetic Field Experiments to Take Place

NASA has chosen 32 proposals for investigations, using the data to be obtained from its soon-to-be-launched Magnetic Field Satellite. Nineteen of the proposals for Magsat were from U.S. principal investigators and 13 came from foreign scientists.

The project, managed by the Goddard Space Flight Center, is designed to measure the near Earth magnetic field on a global basis.

Magsat is one of several elements of NASA's resource observation program. A program goal is to use space techniques to gain an understanding of the dynamic processes which formed the present geologic features of the Earth and how these processes relate to natural hazards and to the emplacement of non-renewable natural resources.

Magsat is to be orbited from the Air Force Western Test Range this month by a Scout launch vehicle. The satellite will be placed in a Sun-synchronous orbit, meaning that the plane of Magsat's orbit always will be perpendicular to the Earth-Sun line. In other words, the satellite will be in a near-polar orbit and always in sunlight. Expected mission duration is about six months.

Objectives of the Magsat mission managers are extensive:

- to obtain an accurate, up-to-date quantitative description of the Earth's main magnetic field;
- to provide data and a worldwide magnetic field model suitable for the U.S. Geological Survey to update and refine magnetic charts and maps;
- to compile global scalar and vector crustal magnetic anomaly maps. The spatial resolution goal for the anomaly map is 300 km;
- to interpret the crustal anomaly map, in conjunction with correlative data, in terms of geologic geophysical models of the Earth's crust, thus providing information that can be used to assess natural resources and determine exploration strategies for the future.

Magsat data will provide field models and global and regional charts for the 1980s.

Analysis and interpretation of Magsat data will be the responsibility of a team of U.S. and foreign scientists whose proposals were selected through a peer group evaluation process.

Before the satellite era began, magnetic data from many geographic regions, particularly oceanic and polar regions, were nonexistent or sparse. The NASA polar orbiting geophysical observatory satellites made global measurements of the magnetic field from October 1965 through June 1971, and several geomagnetic field models based on satellite data have been published. Data from the satellites also resulted in the first global magnetic anomaly map, even though these multipurpose missions were not designed primarily for the study of near-Earth fields.

The Magsat mission, with its increased resolution and higher signal levels from the anomalous fields, is designed to overcome some of the shortcomings of the data from the earlier satellites for making anomaly maps.

New Deputy Associate Administrator

Dr. Walter B. Olstad assumed the position of Deputy Associate Administrator for Aeronautics and Space Technology on Oct. 1. Under the director of the OAST Associate Administrator, Olstad is responsible for the general management and direction of the OAST programs.

Olstad began his NASA career at the Langley Research Center in 1954 as an aeronautical research engineer, serving first in the transonic tunnels branch and then in the reentry physics branch. He was named chief of the gas physics section in 1966 and chief of the advanced entry analysis branch in 1969. He was appointed chief of the space systems division in July 1975.

A native of Greenport, N.Y., Olstad earned his bachelor of science degree in mechanical engineering from Brown University in 1954. In 1958, he earned his master of science degree in aerospace engineering from Virginia Polytechnical Institute and State University and his doctor of philosophy degree in applied mathematics in 1966 from Harvard University.

Olstad has specialized in the fields of aerothermodynamics, radiation heat transfer, applied mathematics, numerical analysis and in the management of research and development programs. He has authored or co-authored more than 40 technical papers.

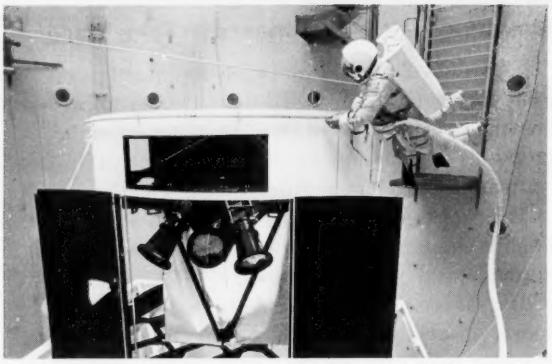
He is a member of the American Institute of Aeronautics and Astronautics, and serves on the AIAA Technical Committee on Space Systems. He is associate editor of the *Journal of Spacecraft and Rockets.*

Teachers Workshop Held at Houston

Dozens of teachers from the DoD schools for dependents recently spent two weeks in the Houston area being updated and briefed on the latest developments in the aerospace field. The meeting was sponsored by NASA, the University of Houston, and the DoD. Most of the participants, including representatives from the Phillipines, Germany, Azores, Japan, Spain, England, and other countries, left soon afterward for their overseas assignments.

The teachers were exposed to various NASA topics including: solar power satellites, the Space Shuttle, lunar science, astronaut training and selection, physiological training (including demonstrations of space suits), aircraft operations (T–38, WB–57, KC–135, Super Guppy, Shuttle training aircraft), the Skylab training facility, and Earth observation. The group also spent a day at the Federal Aviation Administration air route traffic control center and control tower at the Houston Intercontinental Airport. The teachers learned about pilot training procedures, aircraft maintenance, aircraft avionics and the future needs of the general aviation industry as well.

Teaching Teachers—These are several of the many teachers from all over the world who participated in the teacher workshop program held at Houston last summer.



Submerged Spaceman—A pressure-suited astronaut works underwater in the neutral buoyancy simulator at the Marshall center. Astronaut Bruce McCandless used the tank to evaluate methods and equipment which might be used to service the Space Telescope in Earth orbit. A scuba-diver is on hand to assist the astronaut, if needed.

Pressure-suited astronauts from the Johnson Space Center, together with Marshall center engineers, have been conducting the checkout activities in a 5-million-liter water tank facility, known as a neutral buoyancy simulator. It allows a close approximation of a zero-gravity environment. A full-scale mockup of a portion of the Space Telescope is submerged in the tank to allow astronauts and engineers to conduct simulation exercises. Eventually a virtually complete mockup will be constructed in the tank.

Astronaut Candidates Bruce McCandless and George Nelson recently tested the difficulty of unlatching a door to the telescope's star trackers and other components, and determined optimum type and location of foot restraints and hand-holds. The underwater tests are conducted to decide what modifications, if any, are needed to permit removal and replacement of components in space, and the time needed for such tasks.

The Space Telescope, scheduled for launch by the Space Shuttle in late 1983, can be retrieved while in orbit and positioned in the Shuttle orbiter's cargo bay, where space-suited astronauts can service it as needed. The Marshall center has overall management responsibility for development of the Space Telescope. Lockheed Missiles and Space Co., Sunnyvale, Calif., is developing the module under contract to NASA.

Space Telescope Servicing Studied

Underwater tests to evaluate methods and equipment that might be used to service the Space Telescope, once it is stationed in Earth orbit, are being conducted at the Marshall Space Flight Center.

Test Pilot Stationed at Ames Is Promoted

Robert K. Merrill, the project pilot on the Rotor Systems Research Aircraft (a joint Army-NASA program), recently was promoted to the rank of Lieutenant Colonel during special ceremonies held

recently at the NASA Ames Research Center. He is a test pilot assigned to the Aero-mechanics Laboratory of the Army Research and Technology Laboratories at Ames. His flight experience includes more than 3,100 hours in 23 different types of aircraft.

The Rotor Systems Research Aircraft is a test vehicle used by the Army and NASA to evaluate a wide variety of existing and future rotor and propulsion systems. First flown as a pure helicopter, the aircraft now has been fitted with two turbofan engines, a 14-meter variable incidence wing, a stabilator, and a small stabilizer for tests as a compound helicopter. One of two of the two existing such aircraft is now undergoing tests at Ames and the second will be shipped to Ames this fall from NASA's Wallops Flight Center.

Aircraft Inspection—Dr. Alan M. Lovelace, NASA Deputy Administrator, looking into the cockpit of the AD-1 aircraft, with project manager Bill Andrews. The aircraft is expected to make its first flight in the near future.

New Consolidated NASA Resident Office at JPL

Effective Aug. 1, a NASA resident office was established at the Jet Propulsion Laboratory. The new office will be a component installation of NASA headquarters, reporting to the Associate Administrator for Management Operations and geographically located at JPL in Pasadena, Calif.

In announcing the new office, Dr. Alan M. Lovelace explained that: "The office will be a focus for the full range of NASA institutional management interests at JPL. These matters include those which cut across program lines, or are essentially non-programmatic in nature and involve issues that need to be addressed primarily from an institutional perspective. Examples of such issues include manpower ceilings and controls, work for other agencies, organization and key personnel changes, and office space requirements."

The two existing resident offices, the NASA resident legal office-JPL and the NASA resident procurement office-JPL, have been abolished and their functions and personnel transferred intact to the new office. John H. Warden, presently the manager of the NASA resident legal office at JPL, is redesignated as chief counsel and Allen T. Burke, presently manager, NASA resident procurement office at JPL, is redesignated director, procurement division. Warden and Burke will continue to have direct working relationships with their respective functional counterparts at NASA headquarters.

Richard J. Wisniewski, Assistant Associate Administrator for Management Operations at headquarters served as interim acting manager of the new NASA resident office.

In late August, Ann P. Bradley was named manager of the NASA Resident Office at JPL. To provide for the orderly transition of her former responsibilities, for approximately 60 days, she continued to serve as director of administration at Dryden Flight Research Center, where she had been assigned since July 1976.

Bradley joined NASA in 1973 as a personnel management specialist at headquarters. From September 1974 to June 1975, she attended Princeton University through NASA's Executive Development Program as a Princeton Fellow in Public Affairs in the Woodrow Wilson School. When she returned from Princeton in 1975, she became executive assistant to Dr. George M. Low, then Deputy Administrator of NASA.

She is a native of Washington, D.C., where she attended the George Washington University and received a Bachelor of Science degree in Administration.

Bradley previously served in the USAF and has worked for the Office of Economic Opportunity, the Agency for International Development and the Central Intelligence Agency in Washington, D.C.

Contractor News

United Services, Inc. of Washington, D.C. has won a $2.4 million NASA contract extension for the second year of a three-year contract for custodial services at the Kennedy center. These include janitorial services, trash and garbage disposal and clean-room work. The extension, covering Sept. 1, 1979 through Aug. 31, 1980, brings the approximate value of the contract to $7.7 million.

Pan American World Airways, Inc., Aerospace Services Division, of Cocoa Beach, Fla., has been selected by the Johnson center for negotiations leading to the award of a cost-plus-award-fee contract for engineering support services. The contract, valued at some $1.3 million, covers engineering design support for facilities and test programs at JSC.

Oklahoma State University at Stillwater has been chosen by NASA for negotiations leading to a cost-reimbursement kind of contract for the operation and management of the Aerospace Education Services Project. The one-year contract, with renewal options for four years, is worth $792,241; the total for four years would be $3.5 million.

TRW Space Systems Division of Redondo Beach, Calif., has been selected by the Jet Propulsion Laboratory for negotiation of a contract to design, build and test one of two spacecraft whose mission is to explore the Sun's polar regions during the 1980s. The proposed value of the contract is about $80 million. Called the International Solar Polar Mission, the venture is sponsored jointly by NASA and the European Space Agency.

Public Affairs Chief Resigns

Robert A. Newman resigned in September as NASA's director of public affairs to become director of public affairs at Philip Morris, Inc. in New York City.

Since July 1976, Newman has been responsible for a broad range of activities including educational affairs, community relations, public information and relations with news outlets. He came to NASA from TRW, Inc., where he was vice president of community affairs and president of the TRW Foundation at Cleveland, Ohio. He was with TRW from 1966 to 1976.

A native of Childress, Texas, Newman attended the University of Missouri, receiving a Bachelor of Arts degree in sociology and a Bachelor of Journalism degree. He served in the U.S. Air Force during the Korean war, graduating from the Armed Forces Language School as a specialist in the Russian language.

At TRW, Newman received the Silver Anvil Award; he received citations from the U.S. government for public affairs work with the Industrial College of the Armed Forces, along with other national advertising and public relations awards.

Two Executive Changes

Richard G. Smith, in recent months the primary NASA spokesman for Skylab developments, became director of the NASA Kennedy Space Center in September.

He succeeded Dr. Lee R. Scherer, who was named Associate Administrator for External Relations at NASA headquarters, effective Sept. 2, 1979. Smith most recently served as Deputy Associate Administrator for Space Transportation Systems. Before that, he was deputy director of the Marshall Space Flight Center.

Before Scherer became director of the Kennedy center in January 1975, he had served as director of NASA's Dryden Flight Research Center, Edwards, Calif., from Oct. 11, 1971. Earlier he was director of the Apollo Lunar Exploration Office. While on temporary assignment from the U.S. Navy in 1962, he was program manager for the Lunar Orbiter, the unmanned spacecraft which obtained close-up photographs that helped in the selection of Apollo landing sites.

Scherer received a bachelor of science degree in naval science from the U.S. Naval Academy in 1942, a bachelor of science degree in aeronautical engineering from the U.S. Naval Postgraduate School in 1949, and a master of science degree from the California Institute of Technology in 1950.

Among his many honors are: the NASA Exceptional Service Award, the NASA Exceptional Scientific Achievement Medal, the NASA Distinguished Service Medal, and an honorary doctorate in engineering science from the University of Central Florida in 1979.

Smith transferred to NASA in July 1960 from the rocket research and development team at the Redstone Arsenal in Huntsville, when the development operations division of the Army Ballistic Missile Agency became the nucleus for the Marshall Space Flight Center.

Born in Durham, N.C., Smith received a bachelor of electrical engineering degree from Auburn University in 1951.

Taylor Appointed Inspector General for NASA

President Carter approved the appointment of Eldon D. Taylor as NASA's first Inspector General in late July. Taylor returns to NASA from the National Science Foundation where for the last six years, he was assistant director for administration.

He left NASA in 1970 after 10 years in the Office of Space Science and Applications. He also served in the Environmental Protection Agency as the deputy assistant administrator for resource management before going to the National Science Foundation.

Taylor holds an advanced degree in public administration from American University, and he has received the William A. Jump Meritorious Award, the NASA Exceptional Service Award, the Environmental Protection Agency's Special Achievement Award, and the National Science Foundation's Distinguished Service Award.

Marshall Astronomer Is Authority on Diatoms

Richard Hoover of the Marshall Space Flight Cetner space sciences laboratory has a strong interest in telescopes and microscopes—which explains his interest in his vocation and avocation, astronomy and diatoms.

An article prepared by Hoover, "Those Marvelous Myriad Diatoms," was published in the June 1979 issue of *National Geographic Magazine*.

"Diatoms are the most abundant form of plant life on Earth," said Hoover. "People may not know it, but almost everyone has seen them growing on ponds, lakes and oceans. They are responsible for more than 50 percent of the conversion of carbon dioxide to oxygen for human consumption, and they are the key supporter of the entire marine food chain."

Hoover, who has a personal collection of more than 12,000 species, including one dating back 60 million years, is recognized as an authority on diatoms.

Richard Hoover displays pages in the *National Geographic Magazine* which contain his article on diatoms.

Ames Woman Named to F.E.W. Post

A new national vice president of the organization of Federally Employed Women (FEW) was named at a recent national conference in Seattle, Wash. She is Annette T. Laboy of the Ames Research Center Equal Opportunity Office.

An active member of FEW for five years, Laboy organized the South Bay chapter in Mountain View (Calif.) and served as its first president. In her new post, she will vice president for training, responsible for developing and training regional and chapter officers. She also will organize a speakers' bureau and a resource list for the national organization. Laboy previously served the organization as regional representative for the San Francisco region which includes California, Nevada, Arizona, Hawaii, Guam and Japan.

The private organization was founded in 1968 to promote the interests of women in the federal government by increasing job opportunities and improving the merit system. It is the only independent national organization whose sole concern is to help women achieve equal opportunity in the federal service.

New Acting Deputy Director at JSC

Clifford E. Charlesworth, 48, was appointed acting deputy director of the Johnson Space Center effective Aug. 10. Charlesworth replaces Sigurd A. Sjoberg.

Formerly, Charlesworth was deputy manager, Shuttle payload integration and development program office, for three years. As such, he was responsible for the coordination between Space Shuttle users and the Space Shuttle technical management at the Johnson center.

Before that, Charlesworth was manager of the Earth resources program office at JSC. That was NASA's lead office for the development and application of Earth resources information. From 1970 through 1972, he was deputy manager of the Skylab program.

Charlesworth joined NASA in Houston in 1962 as a flight controller. He served as a flight director for the Gemini and Apollo missions and was one of the flight directors for the Apollo 11 Moon mission in 1969.

He holds a bachelor of science degree in physics from Mississippi College, Clinton, Miss.

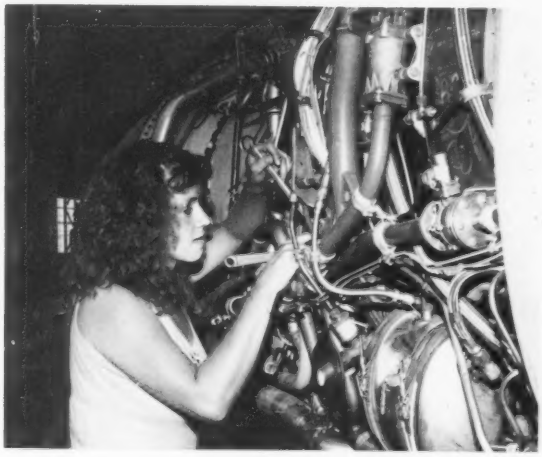
Landsat–D Building Dedicated—On June 18 the General Electric Space Division Landsat building was dedicated. Located near Goddard center in Lanham, Md., the 3,680 square-meter facility will house about 300 GE employees whose main function will be to design, fabricate, and test the Landsat–D data handling systems. Much of the software for the observatory also will be developed there. Landsat–D will be launched in late 1981 as a follow-up to the Landsats now in orbit. Present at dedication ceremonies were (l. to r.): Sam Keller, NASA's Deputy Associate Administrator for Space and Terrestrial Applications; Dr. Robert E. Smylie, acting director of Goddard; Larry Hogan, Prince George's County Executive; Congresswoman Glady Spellman; and Lee Farnham, GE's General Manager.

Launches for 1979

Name	Launch Date	Vehicle	Range	Mission Remarks
SCATHA	Jan. 30	Delta	ETR	DoD R&D. Spacecraft charging at high altitude Reimbursable.
SAGE-A	Feb. 18	Scout	WFC	NASA applications satellite. Stratospheric aerosol and gas experiment.
FLTSATCOM-B	May 3	Atlas Centaur	ETR	DoD Navy communication satellite. Reimbursable.
NOAA-A	June 27	Atlas-F	WTR	NOAA weather satellite. Reimbursable.
UK-6	June 2	Scout	WFC	UK scientific satellite. Reimbursable.
Westar-C, C/U	Aug. 9	Delta	ETR	Western Union communications satellite.
HEAO-C	Sept. 20	Atlas Centaur	ETR	Third high energy astronomical observatory to study highly energetic radiation from space.
MAGSAT-A	October	Scout	WTR	NASA applications satellite to study magnetic field.
FLTSATCOM-C	December	Atlas Centaur	ETR	DoD Navy communications satellite. Reimbursable.
RCA-C	December 7	Delta	ETR	Domestic communications satellite. Reimbursable.

Rockets, Rockets Everywhere—The Johnson Space Center was the site of a week-long annual meeting of the national Association of Rocketry this past summer. More than 100 members attended, many of whom entered a contest for national winners, as well as a competition for teams to represent the United States in an international competition to be held in 1980. The first photo shows members making ready for launches; in the second one, a solitary rocketeer plots his trajectory course; the third shows a small rocket at the moment of launch; and the fourth captures that rapturous moment when a home-made projectile reaches the skies.

Winners for Creative Scientific Endeavor—NASA award-winners at the 1979 International Science and Engineering Fair, held at San Antonio, Texas, last May, received a trip with their teachers to view the Voyager 2 encounter with Jupiter on July 8 and 9. The eight students, teachers, and NASA personnel are pictured with a model of the Voyager spacecraft at NASA's Jet Propulsion Laboratory.



Equal Opportunity Personified—Dinah Moore, with wrench in hand, works at the Dryden center on an engine for the KC–135 aircraft. Moore is the first woman aircraft mechanic at the NASA center.

Another Dividend from Air and Space

Research and development in aeronautics and space have provided numerous benefits for all Americans—and at a tiny percentage of the tax dollar. Here is an example:

Woodburning Heaters

On Apollo missions, the Lunar Module served as home and operating base for astronauts exploring the lunar surface. Since the Moon has no layer of atmosphere to filter the Sun's rays, the Lunar Module was exposed to extremely high daylight temperatures. To help cool the spacecraft, NASA employed a protective exterior coating capable of casting off, rather than absorbing, the radiant energy produced by the Sun. NASA selected an existing high temperature coating called Pyromark and asked the manufacturer to improve it to space-use specifications. Developed by Tempil Division of Big Three Industries*, South Plainfield, N.J., Pyromark proved effective on the Lunar Module and it is similarly used on the Space Shuttle.

The characteristics which make Pyromark useful in spacecraft protection are similarly beneficial in other high temperature applications. Pyromark is used as a protective coating for a number of commercial products including high-efficiency wood burning heaters that fit into a home fireplace shown in the accompanying photo, Pyromark protects against temperatures of up to 1,800 degrees Fehrenheit.

* NASA does not endorse commercial products developed as a result of its Technology Utilization or Patent Licensing Programs, but it does encourage the widest possible use of such technology.

Woodburning Heater—Fitting into a home fireplace, this patented heat exchanger recirculates heated air from the upper ducts back into the room with little waste of energy because the heat does not go up the chimney. (Manufacturer is Aeroheater Co., Inc., Fairfax City, Va.*)

For the benefit of all . . .

NASA
National Aeronautics and Space Administration

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